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<b>(54) Title:</b> INJECTION MOULD FOR DISC-LIKE PLASTIC OBJECTS AND MULTIPLE INJECTION MOULDING UNIT  <b>(57) Abstract</b>  Injection mould for manufacturing disc-like plastic objects with a central hole, which mould comprises: a first mould part; a second mould part displaceable relative to this first mould part; which two mould parts are displaceable between a closed first position, in which they together partially bound a mould cavity corresponding to the shape of an object for manufacture, and an open second position in which a formed object can be removed; a third mould part which in an active position extends through the mould cavity and in the region of this mould cavity has a shape corresponding to the shape of the central hole, which third mould part is axially displaceable relative to the first and second mould parts between said active position and a retracted rest position; which third mould part bounds with the guide sleeve a channel which is connectable to the injection nozzle of an injection moulding device, which channel can be opened and closed by means of a valve consisting of a valve seat which is formed by a part of the inner surface of a guide sleeve widening towards the mould cavity and a valve body which is formed by a widened portion on the relevant end of the third mould part; which valve body can be displaced to the active position of the valve by the pressure of the plastic supplied through the channel and can be displaced to the rest position by a pressure member; and first heating means co-acting with guide sleeve for keeping plastic present in the channel in the plastic state.		

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**INJECTION MOULD FOR DISC-LIKE  
PLASTIC OBJECTS AND MULTIPLE INJECTION MOULDING UNIT**

From EP-A-0 566 266 an injection mould is known for manufacturing disc-like plastic objects with a central hole, which mould comprises:

a first mould part;

5 a second mould part displaceable relative to this first mould part by means of first displacing means;

which two mould parts are displaceable between a closed first position, in which they together partially bound a mould cavity corresponding to the shape of an  
10 object for manufacture, and an open second position in which a formed object can be removed;

a third mould part which in the closed position of the first and second mould parts extends through the mould cavity defined thereby and in the region of this  
15 mould cavity has a shape corresponding to the shape of the central hole, which third mould part is axially displaceable between a first position, in which it partially forms a boundary of the mould cavity, and a retracted second position by means of second displacing  
20 means by means of a guide sleeve forming part of the first mould part;

which third mould part bounds a channel which is connectable on the free outer end to the injection nozzle of an injection moulding device and on the other  
25 side debouches with an injection inlet into the region of the mould cavity in the first position of the first and the second mould parts and the first position of the third mould part, and in the second position of the third mould part debouches blind against the inner wall  
30 of the guide sleeve; and

heating means for keeping plastic present in the channel in the plastic state.

It is an object of the invention to improve this known injection mould in a number of respects. In this respect the invention provides an injection mould for manufacturing disc-like plastic objects with a central  
5 hole, which mould comprises:

a first mould part;

a second mould part displaceable relative to this first mould part by means of first displacing means;

10 which two mould parts are displaceable by means of the first displacing means between a closed first position, in which they together partially bound a mould cavity corresponding to the shape of an object for manufacture, and an open second position in which a formed object can be removed;

15 a third mould part which in an active position extends in the closed position of the first and second mould parts through the mould cavity defined thereby and in the region of this mould cavity has a shape corresponding to the shape of the central hole, which  
20 third mould part is axially displaceable relative to the first and second mould parts between said active position in which it forms a partial boundary of the mould cavity and a retracted rest position by means of second displacing means by means of a guide sleeve  
25 forming part of the first mould part;

which third mould part bounds with the guide sleeve a channel which is connectable at its free end remote from the mould cavity to the injection nozzle of an injection moulding device,

30 which channel can be selectively opened and closed at its end adjacent to the mould cavity by means of a valve consisting of a valve seat which is formed by a part of the inner surface of the guide sleeve widening towards the mould cavity and a valve body which is  
35 formed by a widened portion on the relevant end of the third mould part such that in the open active situation of the valve the channel debouches in annular manner

into the mould cavity and in the closed rest position of the valve the channel is separated from the mould cavity;

which valve body can be displaced to the  
5 active position of the valve by the pressure of the plastic supplied through the channel and can be displaced to the rest position by a pressure member extending through the second mould part, wherein the activity of the pressure member and the supply of  
10 plastic never occur simultaneously; and  
first heating means co-acting with the guide sleeve for keeping plastic present in the channel in the plastic state.

In order to combine a reliable closure of the valve  
15 with a low pressure on valve body and valve seat in the contact surfaces, an embodiment is recommended in which the valve body has substantially the same shape as the valve seat.

Use can be made of an annular ring of passage  
20 openings with which the channel debouches in the mould cavity. An embodiment is however recommended in which the channel debouches in the mould cavity via an annular opening. In this preferred embodiment an inflow is ensured which is as homogenous as possible.

25 In a specific embodiment the mould according to the invention has the feature that at least the outer surface of the valve body has a hardness which corresponds at least to that of hard metal.

This latter embodiment can advantageously have the  
30 special feature that at least said outer surface consists of ceramic material.

A specific embodiment has the special feature that the third mould part is carried slidably by the guide sleeve by means of a number of guide protrusions present  
35 on the guide sleeve and/or on the third mould part. The guide protrusions can be arranged as desired on the inner surface of the guide sleeve or on the out r

surface of the third mould part, or a combination thereof. These guide protrusions can advantageously be placed in angularly equidistant manner. For reasons of production technique it is recommended to form the guide protrusions, for instance in the form of ribs, on the third mould part. The guide protrusions must then have a certain dimension in axial direction or use is made of separate protrusions located at mutual axial distance. A reliable axial guiding is hereby realized. The guide protrusions preferably have such a large active surface area in common with the surface co-acting therewith that the pressure between the relevant surfaces is very small. This enhances the lifespan and low friction.

A particular embodiment has the special feature that the third mould part is carried slidably by the guide sleeve by means of a number of guide ribs present on the third mould part which extend in angularly equidistant manner and each have a helical shape. Thus is achieved that the part-flows mutually separated by the guiding ribs form seams which connect poorly to each other and are distinguishable in the final manufactured product. The helical ribs have the effect that the part-flows mix well after being combined. The described phenomenon, which is also designated as "cold flow" is essentially prevented hereby.

For optical information carriers such as CD-audio, CD-ROM, CD-R, CD-i, DVD and the like, it is of the greatest importance that the optical quality of the information carriers, usually consisting of polycarbonate, meets the very highest set standards. In order to realize this objective the mould according to the invention comprises in a preferred embodiment first cooling means acting in the centre zone of the mould cavity for cooling plastic flowing into the mould cavity, which centre zone extends over an area with a diameter of  $(0.30 \pm 0.15)$  times the diameter of the

mould cavity. A substantial quality improvement can be realized by thus tempering the inflowing plastic.

According to another aspect of the invention, in an embodiment in which the valve body has the same shape as  
5 the valve seat and the channel debouches via an annular opening into the mould cavity, the mould according to the invention can have the special feature that the relevant shape is a conical shape.

A specific variant has the special feature that the  
10 top angle of the conical shape has a value of  $(20 \pm 5)^\circ$ .

According to another aspect of the invention the mould can have the special feature that the pressure member is a pressure cylinder which is provided with second cooling means.

15 In order to allow the above described guide protrusions to move with the least possible friction over the surface co-acting therewith, the mould can in accordance with another aspect of the invention have the special feature that the guide protrusions co-act with  
20 the adjacent surface by means of a friction-reducing coating, for instance TiN, DLC (diamond-like carbon).

Such a coating must be heat-resistant and wear-resistant.

According to yet another aspect of the invention  
25 the mould can have the special feature that the coating is applied to all surfaces of the channel and is also of a type which has anti-stick properties relative to the plastic flow-past, for instance TiN, DLC (diamond-like carbon).

30 In a specific embodiment the mould has the special feature that the valve body is releasably connected to the rest of the third mould part and consists of a material with poor heat conduction, for instance a ceramic material. In this case the valve body, which is  
35 subject to erosion and ageing by pressure, can be replaced as desired. The low thermal conduction through

the valve body also prevents undesired thermal couplings being formed.

In order to keep the operation of a mould as manageable as possible, the variant is recommended in  
5 which the heating means are separated from the first cooling means.

This latter variant has the special feature in a specific embodiment that an annular thermal insulator is arranged between the guide sleeve and the first cooling  
10 means.

The invention further provides an injection moulding unit comprising at least two injection moulds for manufacturing disc-like plastic objects with a central hole, each of which moulds comprises:

15 a first mould part;

a second mould part displaceable relative to this first mould part by means of first displacing means;

which two mould parts are displaceable by means of the first displacing means between a closed first  
20 position, in which they together partially bound a mould cavity corresponding to the shape of an object for manufacture, and an open second position in which a formed object can be removed;

a third mould part which in an active position  
25 extends in the closed position of the first and second mould parts through the mould cavity defined thereby and in the region of this mould cavity has a shape corresponding to the shape of the central hole, which third mould part is axially displaceable relative to the  
30 first and the second mould part between said active position in which it forms a partial boundary of the mould cavity and a retracted rest position by means of second displacing means by means of a guide sleeve forming part of the first mould part;

35 which third mould part together with the guide sleeve bounds a channel which is connectable at its free



end remote from the mould cavity to the injection nozzle of an injection moulding device,

which channel can be selectively opened and closed at its end adjacent to the mould cavity by means of a valve consisting of a valve seat which is formed by a part of the inner surface of the guide sleeve widening towards the mould cavity and a valve body which is formed by a widened portion on the relevant end of the third mould part such that in the open active situation of the valve the channel debouches in annular manner into the mould cavity and in the closed rest position of the valve the channel is separated from the mould cavity;

which valve body can be displaced to the active position of the valve by the pressure of the plastic supplied through the channel and can be displaced to the rest position by a pressure member extending through the second mould part, wherein the activity of the pressure member and the supply of plastic never occur simultaneously; and

first heating means co-acting with the guide sleeve for keeping plastic present in the channel in plastic state.

The invention will now be elucidated with reference to the annexed drawings. In the drawings:

figure 1 shows a longitudinal section through a mould according to the invention which is connected to the injection nozzle of an injection moulding device;

figure 2 shows a detail of a mould according to figure 1 on enlarged scale;

figure 3 shows a partly broken-away perspective view of the third mould part;

figures 4, 5, 6, 7 and 8 show details of the mould on enlarged scale in respective operative positions;

figure 9 is a cross-section through an injection mould in another embodiment;

figure 10 shows the third mould part of figure 9 in partly broken-away perspective view;

figure 11 shows in cross-section a dual injection moulding unit with two moulds of the type shown in  
5 figure 9; and

figure 12 shows a dual injection mould in another embodiment.

Figures 1, 2, 4, 5, 6, 7 and 8 show an injection mould 1 for manufacturing disc-like plastic objects with  
10 a central hole. The mould comprises a first mould part 2, a second mould part 3 displaceable relative to this first mould part 2 by means of generally known first displacing means (not shown), which two mould parts 2, 3 are displaceable by means of first displacing means  
15 between a closed first position shown in figures 1, 2, 5, 6, 7, in which they bound together with a ring 5 a mould cavity 6 corresponding to the shape of an object for manufacture, and an open second position designated with 7 in which a formed object 8 can be taken out; a  
20 third mould part 4 (see also figure 3) which in an active position extends in the closed position of the first and second mould parts 3, 4 as according to figures 1, 2, 5, 6, 7 through the mould cavity 6 defined thereby and in the region of this mould cavity 6 has a  
25 shape corresponding to the shape of the central hole 9 of object 8, which third mould part 4 is axially displaceable with the first and second mould parts 2, 3 between said active position in which it forms a partial boundary of mould cavity 6 and a retracted rest position  
30 as drawn in figures 4, 5, 7, 8 by means of second displacing means to be described hereinbelow by means of a guide sleeve 10 forming part of first mould part 2; which third mould part 4 bounds with guide sleeve 10 a channel 11 which is connectable at its free end 12  
35 remote from mould cavity 6 to injection nozzle 13 of an injection moulding device 14, which channel 11 can be selectively opened and closed at its end 15 adjacent to

the mould cavity by means of a valve consisting of a valve seat which is formed by a part 16 of inner surface 17, 35 of guide sleeve 10 widening towards mould cavity 6 and a valve body which is formed by a widened portion 5 on the relevant end 19 of third mould part 4 such that in the open active situation of valve 16, 18 the channel 11 debouches in annular manner into mould cavity 6 and in the closed rest position of valve 16, 18 the channel 11 is separated from mould cavity 6; which valve body 18 10 can be displaced to the active position of the valve (figure 6) by the pressure of the plastic 20 supplied through channel 11 and can be displaced to the rest position by a pressure member 21 extending through second mould part 3, wherein the activity of pressure 15 member 21 and the supply of plastic 20 never occur simultaneously; and first heating means 122 and second heating means 123 co-acting with guide sleeve 10 for keeping plastic 20 present in channel 11 in plastic state. The pressure of the plastic fed through the 20 channel and the pressure member thus form the second displacing means.

An annular constriction 37 serves as stop for mould part 4.

As shown in the figures, valve body 18 can have 25 substantially the same shape as valve seat 16. The drawings show that the shape in question is a conical form with a top angle of about 20°. With the described structure the channel 11 debouches in the region of valve 16, 18 into mould cavity 6 via an annular opening, 30 at least in the active position shown in figure 6.

The third mould part 4 has the shape of a torpedo, as shown clearly in figure 3, and has a generally elongate shape with three guide ribs 22, 23, 24, which are slidable over inner surface 17. Because ribs 22, 23, 35 24 extend over a substantial axial distance and fit with little clearance inside said cylindrical surface 17, the

third mould part 3 is carried in easily slidable manner without substantial radial variation.

Cooling means are selectively active in the centre zone of mould cavity 6. These consist of a cooling  
5 element 25 with cooling channel 26 formed integrally with first mould part 2 or separated therefrom in accordance with the annexed drawings. The front surface 27 of element 25 lies precisely in the same plane as front surface 28 of mould part 2. The effect of the  
10 operation of these cooling means 25, 26 is that in the situation according to figure 6 plastic flowing into mould cavity 6 is cooled, which is found to result in a greatly improved optical quality of the formed disc-like objects, this being particularly important in the case  
15 of transparent disc-like information carriers.

Pressure cylinder 21 can be thermally coupled to a cooling channel 29.

In the present embodiment all surfaces of third mould part 4 and of channel 11 suitable for this purpose  
20 are provided with a coating which has anti-stick properties in respect of the plastic 20 flowing past, is heat-resistant, wear-resistant and reduces the friction between guide ribs 22, 23, 24 and surface 17. An example of such a coating is titanium nitride (TiN), diamond-  
25 like carbon (DLC) or the like.

The protrusion 19 serving as valve body is connected in the manner shown particularly clearly in figure 3 to the rest of the third mould part 4 by means of a screw 30. The valve body can thus be replaced by  
30 another valve body and can moreover consist of a different material. A suitable material is a material which is a poor heat conductor, for instance a ceramic material. The fact that valve body 18 is exchangeable and connected releasably to the rest of the mould part 4  
35 has the advantage that it can be replaced in the case of wear and can moreover be manufactured from a relatively

expensive material without this substantially increasing the total cost of mould part 4, 18.

Guide sleeve 10 is connected to cooling element 25 via a thermally insulating ring 31. Heating element 122 is thus thermally separated from cooling element 25. Hereby is realized in reliable manner that the plastic present in channel 11 is kept in the heated plastic state while the plastic is cooled as it flows into mould cavity 6.

10 In the situation of figure 4 the mould 1 is placed in the closed position by displacing second mould part 3 as according to arrow 32. Valve 16, 18 is closed and the plastic 20 present in channel 11 is pressureless.

Figure 5 shows the situation in which the mould is 15 closed and mould cavity 6 is formed.

Figure 6 shows the following phase in which the plastic 20 in channel 11 is placed under pressure, whereby valve body 18 is displaced to the situation shown in figure 6 in which valve 16, 18 is opened and the plastic is injected via an annular injection zone. In this situation cooling liquid flows through cooling channel 26 for cooling of front surface 27. A certain after-pressure is also exerted after injection. During this phase cooling liquid also flows through cooling 25 channel 29.

Injection is hereby completed. As shown in figure 7, pressure cylinder 21 is displaced to the right as according to arrow 33, whereby valve body 18 is pressed against the valve seat and the valve thereby closed once 30 again. It is noted that under all conditions there is a cylindrical outer surface part 34 of mould part 4 which co-acts with the cylindrical inner surface 17, 35 of channel 11. These two surfaces define the smallest through-flow opening under all conditions. In the 35 situation according to figure 6 this cylindrical through-flow opening connects via an annular radial passage onto the conical passage defined by valve 16,

18. After the situation shown in figure 7 has been reached the disc-like product 8 is finished and the mould can be opened.

Figure 8 shows that for this purpose mould part 3  
5 is displaced to the left as according to arrow 36 such that disc 8 can be taken out.

It is noted that a so-called stamper has been omitted from the drawing, i.e. a disc-like insert in the mould cavity in which the information for transferring  
10 onto the information carrier is displayed in negative form.

After the situation shown in figure 8 has been reached the manufacturing cycle is ended and the device returns to the situation shown in figure 5 for the  
15 manufacture of a subsequent object.

Figure 9 shows a part of an injection mould 101 which forms part of the dual injection moulding unit 102 shown in figure 11.

Mould 101 largely corresponds with mould 1  
20 according to figure 2. An essential difference is the form of the helical guide ribs to be described hereinbelow.

It is pointed out with reference to figure 3 that guide ribs 22, 23, 24 are substantially straight in the  
25 embodiment shown therein. Mould 101 of figure 9 has a third mould part 103 with guide ribs 104, 105, 106 which, as shown, have a generally helical shape, are in angularly equidistant arrangement and have identical shapes.

30 In respect of mould 101 reference is otherwise made to mould 1 according to figure 2.

Figure 10 shows the general torpedo-like third mould part 103.

Attention is drawn to the fact that the conical  
35 widening 19 of third mould part 4 according to figure 3 is embodied in slightly different manner than in third mould part 103 according to figure 10. This is however

not important either functionally or for a good understanding of the invention.

Figure 11 shows that the injection moulding unit 102 comprises two moulds of the type according to figure 9. These two moulds are therefore designated with the same reference numeral, i.e. 101. Attention is drawn to the fact that each of the two moulds comprises a pneumatic pusher unit 107 for urging third mould part 103 to a closed position as shown in figure 9 after the forming of a plastic object. In this position the conical widened portion 19 closes sealingly in the manner of a valve body against the correspondingly formed conical valve seat 16. For the sake of conciseness reference is otherwise made to figures 2, 4, 5, 6, 7 and 8 for the operation of mould 101.

Finally, figure 12 shows a dual injection moulding unit 108 with two injection moulds 109, 110 in an embodiment other than that shown in figure 11 with reference to unit 102.

In injection moulding unit 102 each of the moulds 101 is provided with a third mould part 103 as according to figure 10. This mould part is slidably shiftable in channel 111. In the embodiment according to figure 12 the third mould part 112 is likewise axially shiftable but is guided slidably in the double hot-runner 114 via a continuous hole 113 by means of a guide stem 115 forming part of third mould part 112.

The multiple hot-runner 114 connects with its inlet channel 115 in the same manner as shown in figure 1 onto a plastic-plasticizing and injecting unit of a per se known type. Inlet channel 115 branches into two channels 116, 117 respectively which each supply a part-flow of plastic to the respective moulds 101, 101 respectively 109, 110.

In respect of the embodiments according to figures 11 and 12 respectively it is noted that the advantages in the embodiment of figure 12 may lie in the fact that

the plastic flow in the direction of valve 16, 19 is influenced less and has more the character of a cylindrical jacket-like flow. A widened portion 118 acting as stop can further be positioned in very simple  
5 manner outside mould 109, 110. A drawback of the structure of figure 12 may be that the hot-runner is not fully closed, as is very much the case in the embodiment according to figures 1, 2, 9, and that plastic leakage can therefore occur as a result of the very high  
10 injection pressures.

The invention is not limited to the described embodiments. Specific aspects can for instance be applied separately or also in combination at the choice of a designer.

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**CLAIMS**

1. Injection mould for manufacturing disc-like plastic objects with a central hole, which mould comprises:

a first mould part;

5 a second mould part displaceable relative to this first mould part by means of first displacing means;

which two mould parts are displaceable by means of the first displacing means between a closed first position, in which they together partially bound a mould  
10 cavity corresponding to the shape of an object for manufacture, and an open second position in which a formed object can be removed;

a third mould part which in an active position extends in the closed position of the first and second  
15 mould parts through the mould cavity defined thereby and in the region of this mould cavity has a shape corresponding to the shape of the central hole, which third mould part is axially displaceable relative to the first and second mould parts between said active  
20 position in which it forms a partial boundary of the mould cavity and a retracted rest position by means of second displacing means by means of a guide sleeve forming part of the first mould part;

which third mould part bounds with the guide sleeve  
25 a channel which is connectable at its free end remote from the mould cavity to the injection nozzle of an injection moulding device,

which channel can be selectively opened and closed at its end adjacent to the mould cavity by means  
30 of a valve consisting of a valve seat which is formed by a part of the inner surface of the guide sleeve widening towards the mould cavity and a valve body which is formed by a widened portion on the relevant end of the

third mould part such that in the open active situation of the valve the channel debouches in annular manner into the mould cavity and in the closed rest position of the valve the channel is separated from the mould cavity;

which valve body can be displaced to the active position of the valve by the pressure of the plastic supplied through the channel and can be displaced to the rest position by a pressure member extending through the second mould part, wherein the activity of the pressure member and the supply of plastic never occur simultaneously; and

first heating means co-acting with the guide sleeve for keeping plastic present in the channel in the plastic state.

2. Injection mould as claimed in claim 1, wherein the valve body has substantially the same shape as the valve seat.

3. Injection mould as claimed in claim 1, wherein the channel debouches in the mould cavity via an annular opening.

4. Injection mould as claimed in claim 1, wherein at least the outer surface of the valve body has a hardness which corresponds at least to that of hard metal.

5. Injection mould as claimed in claim 4, wherein at least said outer surface consists of ceramic material.

6. Injection mould as claimed in claim 1, wherein the third mould part is carried slidably by the guide sleeve by means of a number of guide protrusions present on the guide sleeve and/or on the third mould part.

7. Injection mould as claimed in claim 1, wherein the third mould part is carried slidably by the guide sleeve by means of a number of guide ribs present on the third mould part which extend in angularly equidistant manner and each have a helical shape.

8. Injection mould as claimed in claim 1, comprising first cooling means acting in the centre zone of the mould cavity for cooling plastic flowing into the mould cavity, which centre zone extends over an area with a diameter of  $(0.30 \pm 0.15)$  times the diameter of the mould cavity.
9. Injection mould as claimed in claims 2 and 3, wherein the relevant shape is a conical shape.
10. Injection mould as claimed in claim 8, wherein the top angle of the conical shape has a value of  $(20 \pm 5)^\circ$ .
11. Injection mould as claimed in claim 1, wherein the pressure member is a pressure cylinder which is provided with second cooling means.
12. Injection mould as claimed in claim 6, wherein the guide protrusions co-act with the adjacent surface by means of a friction-reducing coating, for instance TiN, DLC (diamond-like carbon).
13. Injection mould as claimed in claim 12, wherein the coating is applied to all surfaces of the channel and is also of a type which has anti-stick properties relative to the plastic flow-past, for instance TiN, DLC (diamond-like carbon).
14. Injection mould as claimed in claim 1, wherein the valve body is connected for optional release to the rest of the third mould part and consists of a material with poor heat conduction, for instance a ceramic material.
15. Injection mould as claimed in claim 1, wherein the heating means are separated from the first cooling means.
16. Injection mould as claimed in claim 15, wherein an annular thermal insulator is arranged between the guide sleeve and the first cooling means.
17. Injection moulding unit comprising at least two injection moulds as claimed in any of the foregoing

claims for manufacturing disc-like plastic objects with a central hole, each of which moulds comprises:

a first mould part;

a second mould part displaceable relative to this  
5 first mould part by means of first displacing means;  
which two mould parts are displaceable by means of the first displacing means between a closed first position, in which they together partially bound a mould cavity corresponding to the shape of an object for  
10 manufacture, and an open second position in which a formed object can be removed;

a third mould part which in an active position extends in the closed position of the first and second mould parts through the mould cavity defined thereby and  
15 in the region of this mould cavity has a shape corresponding to the shape of the central hole, which third mould part is axially displaceable relative to the first and the second mould parts between said active position in which it forms a partial boundary of the  
20 mould cavity and a retracted rest position by means of second displacing means by means of a guide sleeve forming part of the first mould part;

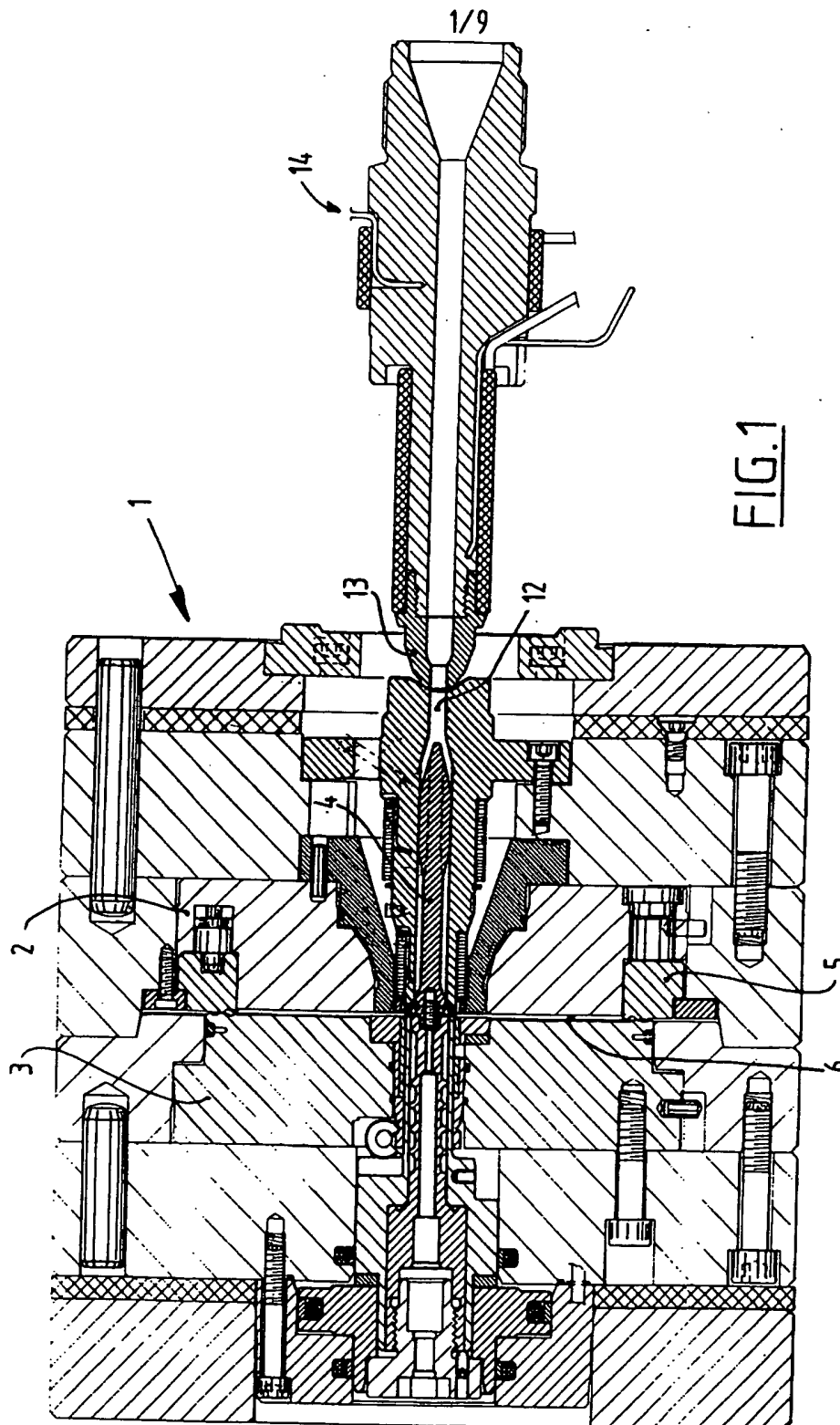
which third mould part together with the guide sleeve bounds a channel which is connectable at its free  
25 end remote from the mould cavity to the injection nozzle of an injection moulding device,

which channel can be selectively opened and closed at its end adjacent to the mould cavity by means of a valve consisting of a valve seat which is formed by  
30 a part of the inner surface of the guide sleeve widening towards the mould cavity and a valve body which is formed by a widened portion on the relevant end of the third mould part such that in the open active situation of the valve the channel debouches in annular manner  
35 into the mould cavity and in the closed rest position of the valve the channel is separated from the mould cavity;

which valve body can be displaced to the active position of the valve by the pressure of the plastic supplied through the channel and can be displaced to the rest position by a pressure member  
5 extending through the second mould part, wherein the activity of the pressure member and the supply of plastic never occur simultaneously; and

first heating means co-acting with the guide sleeve for keeping plastic present in the channel in plastic  
10 state.

\*\*\*\*\*



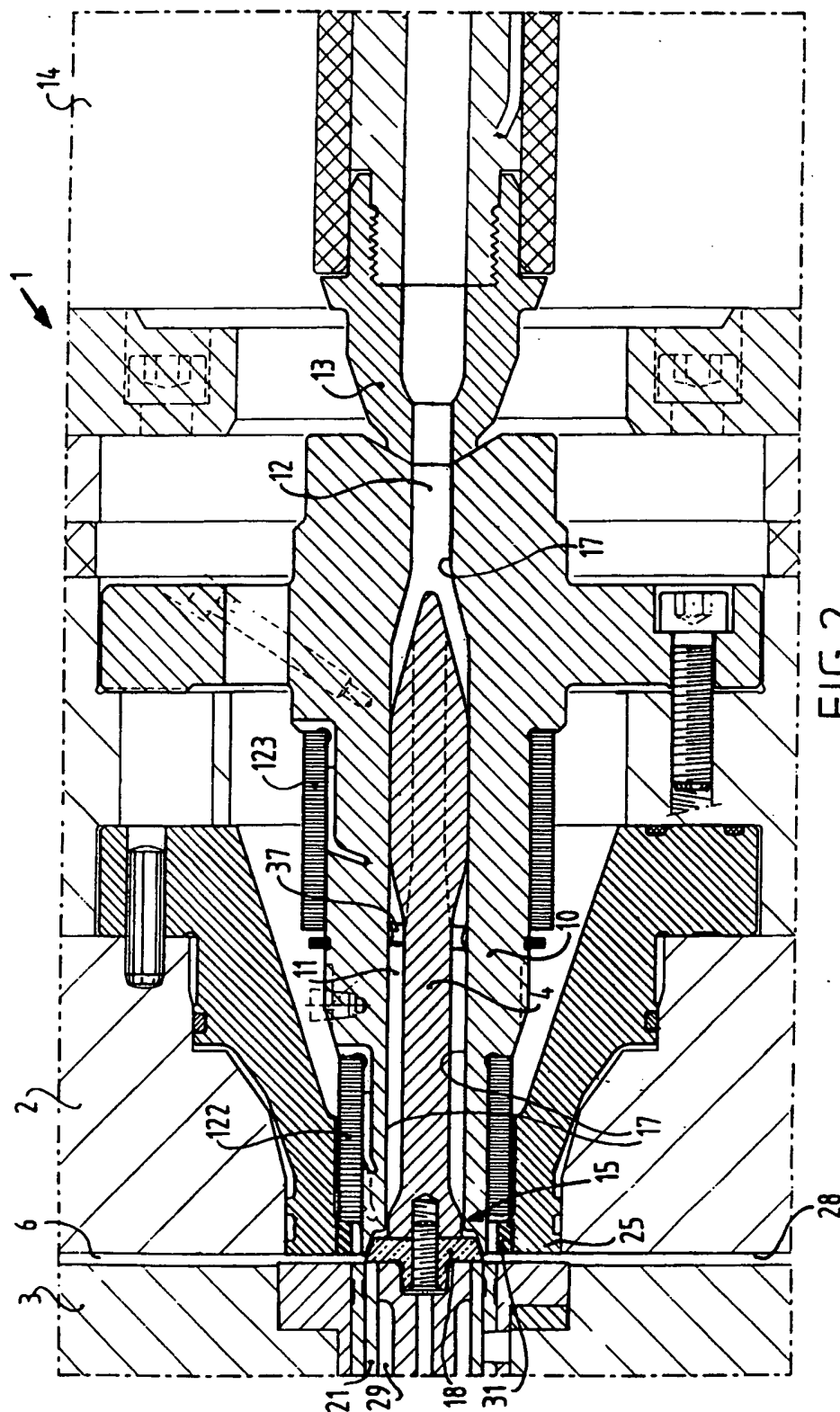
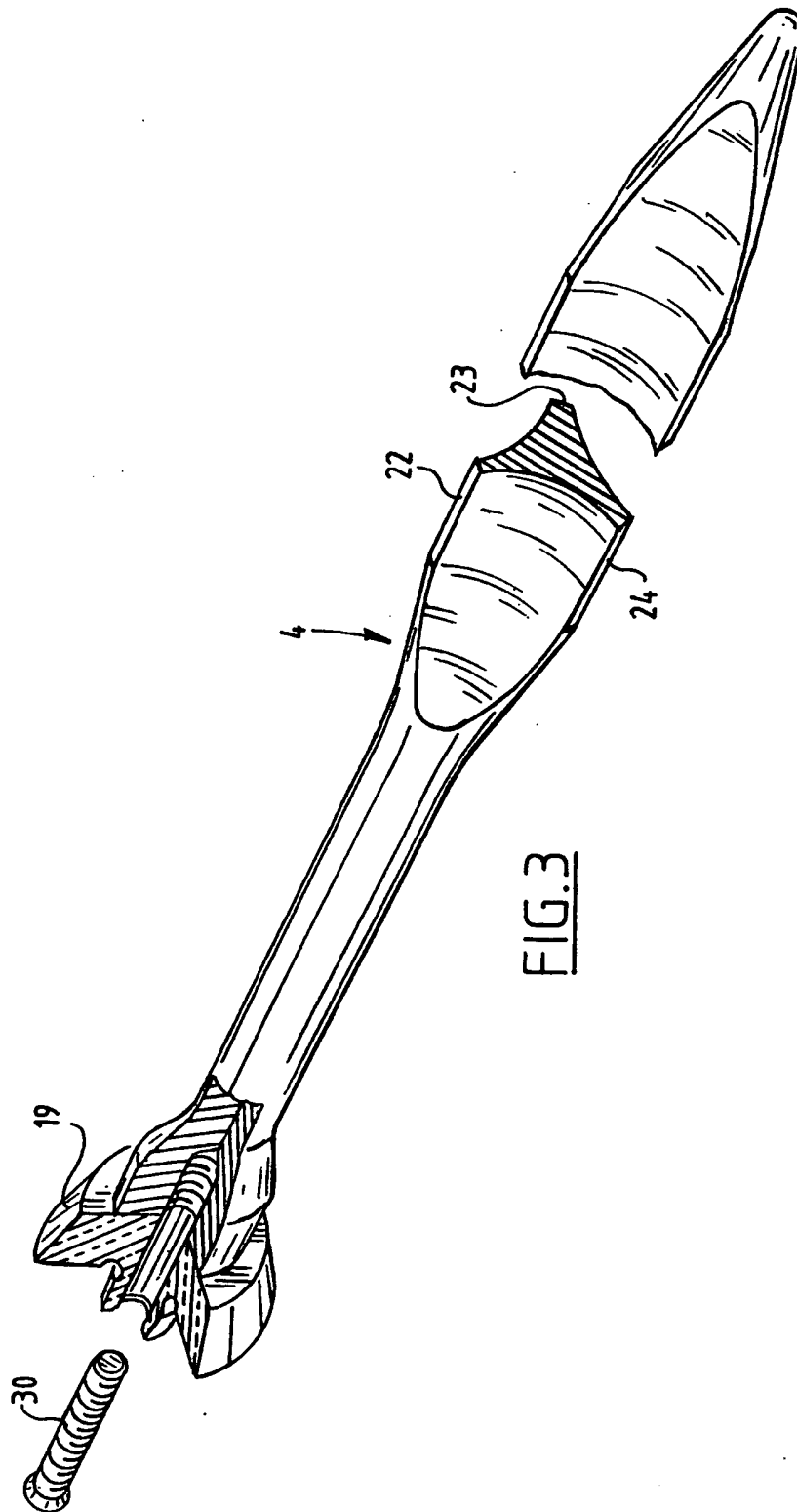
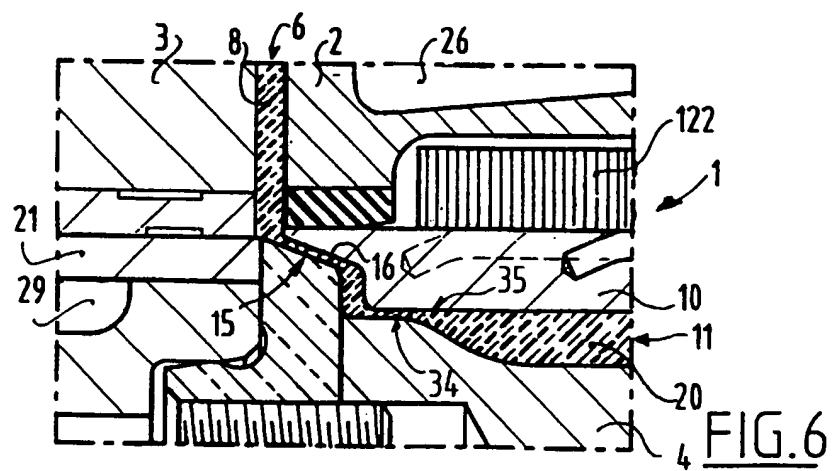
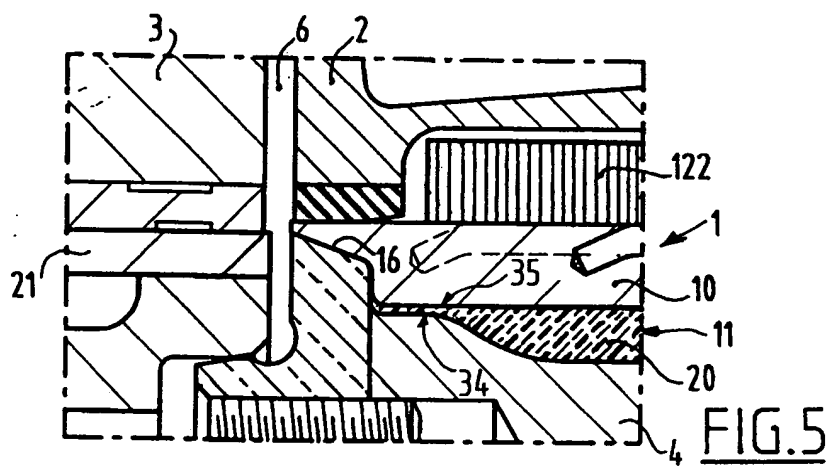
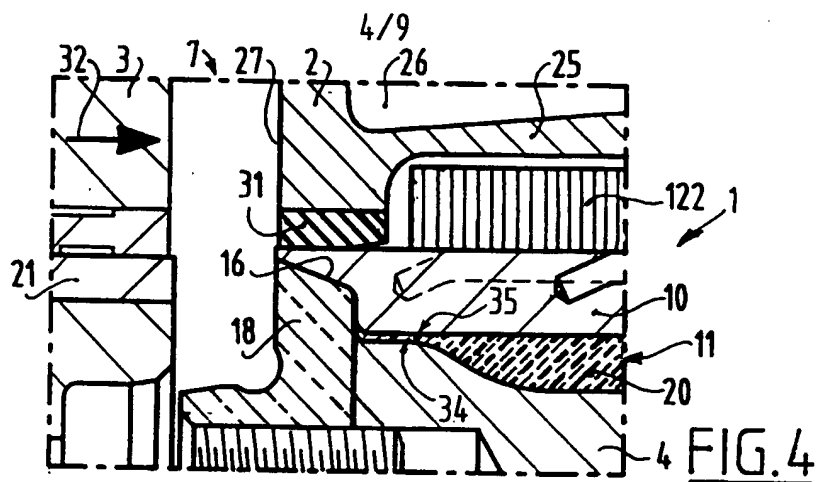


FIG. 2

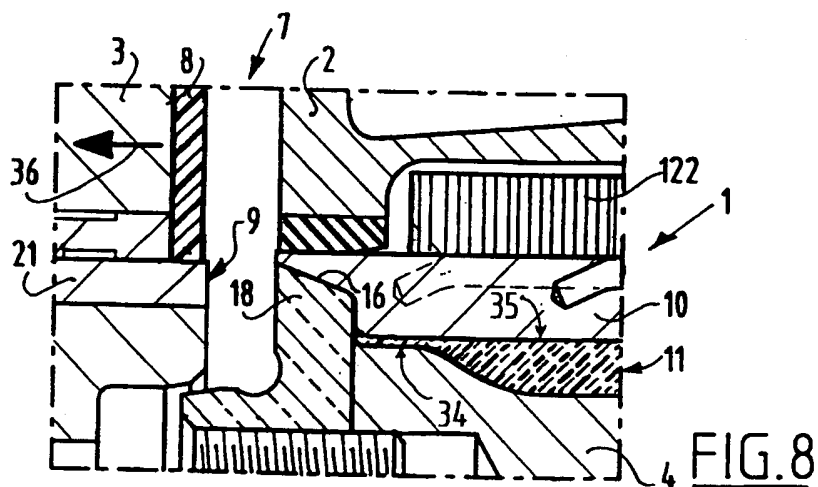
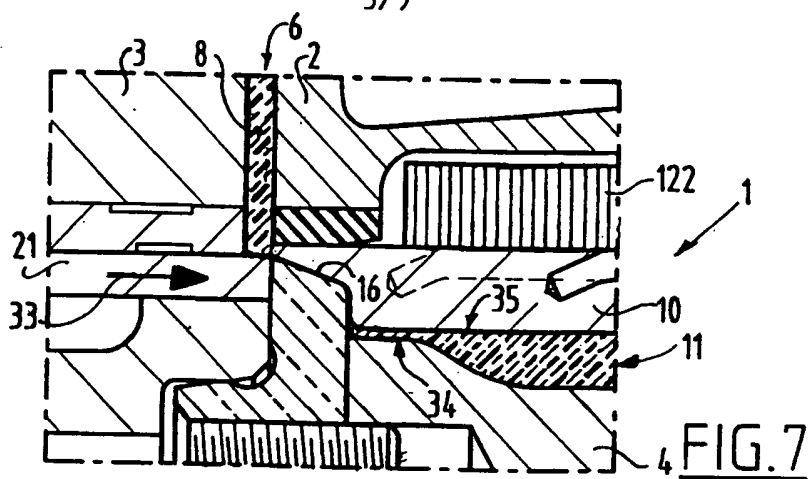
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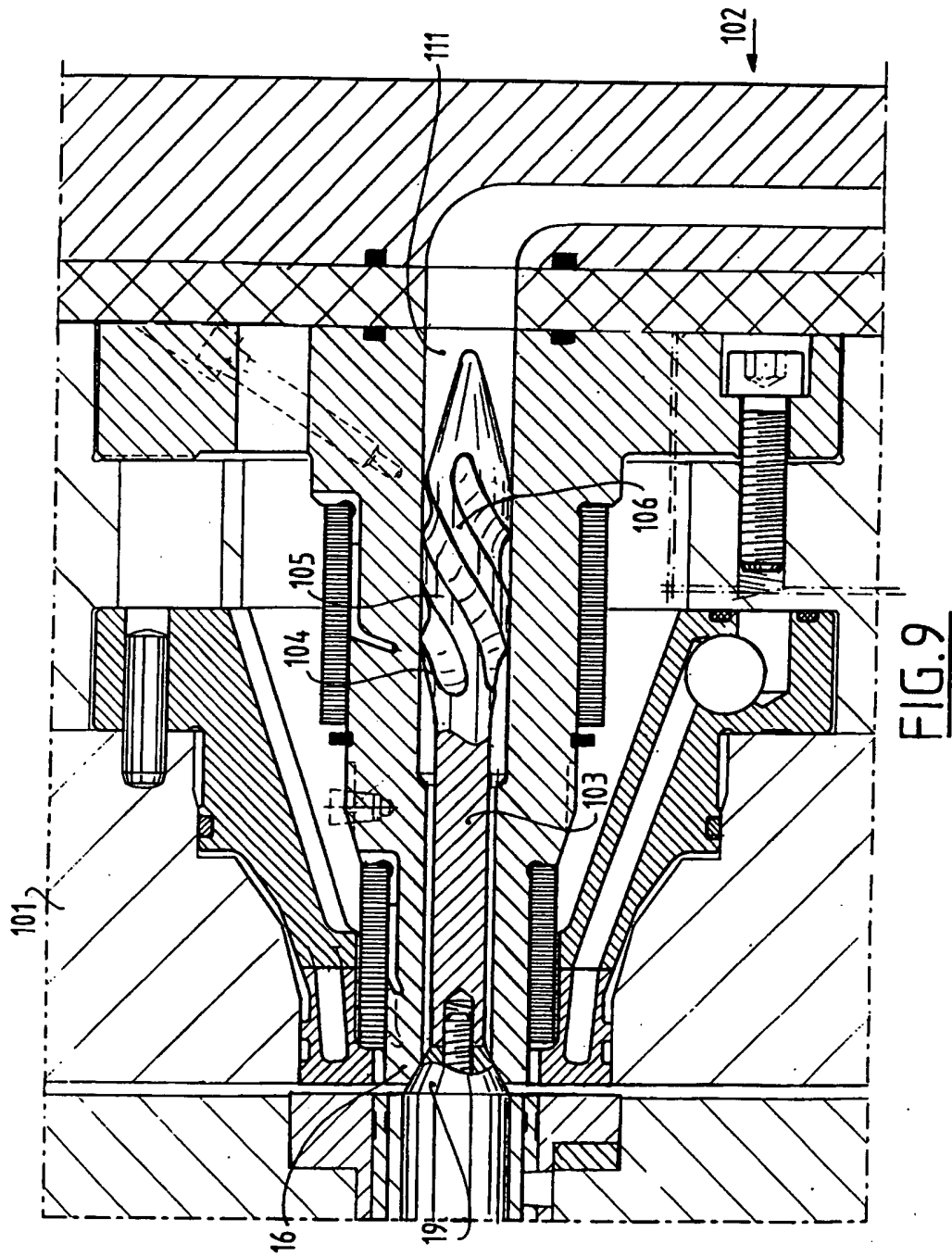






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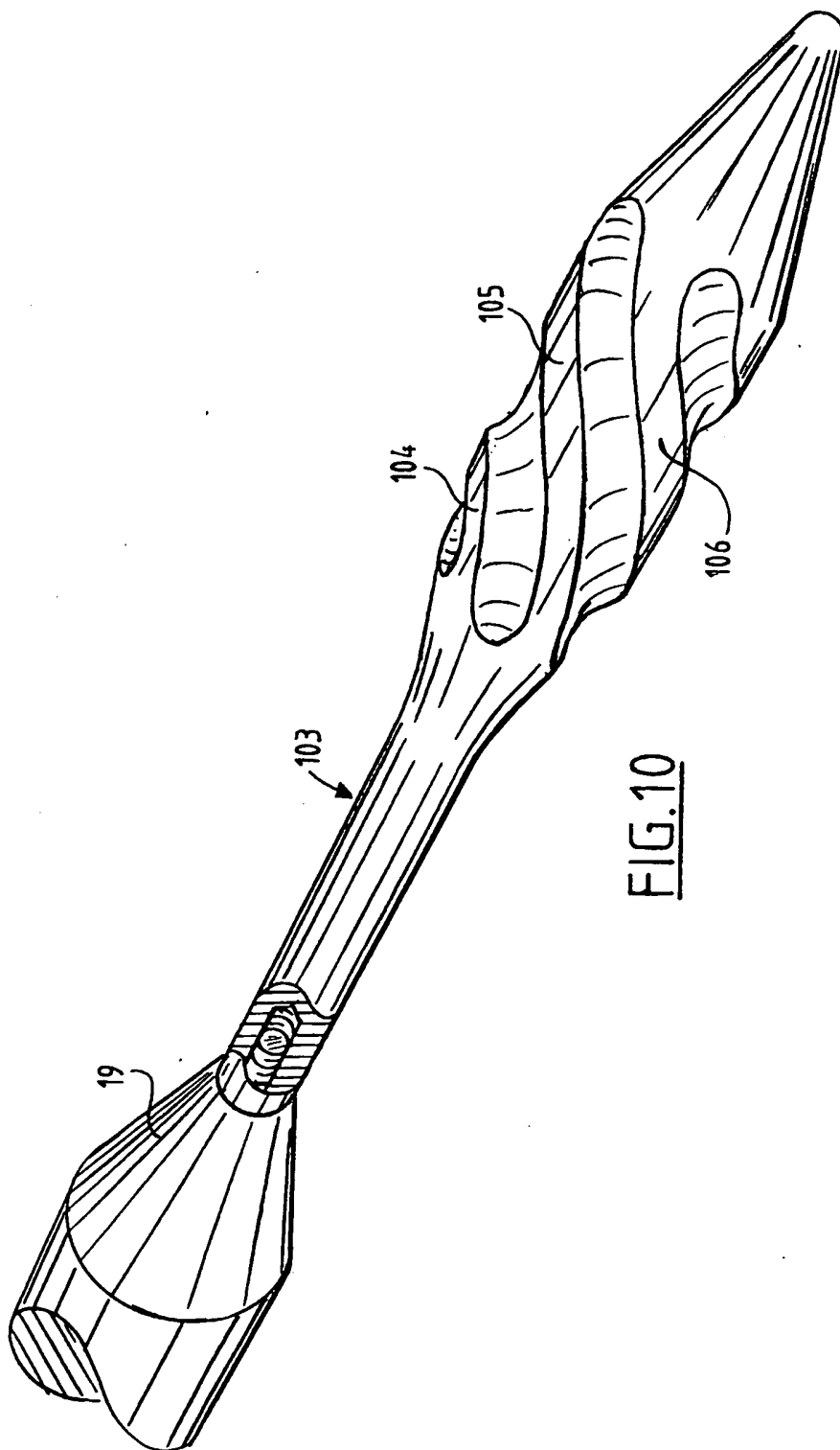
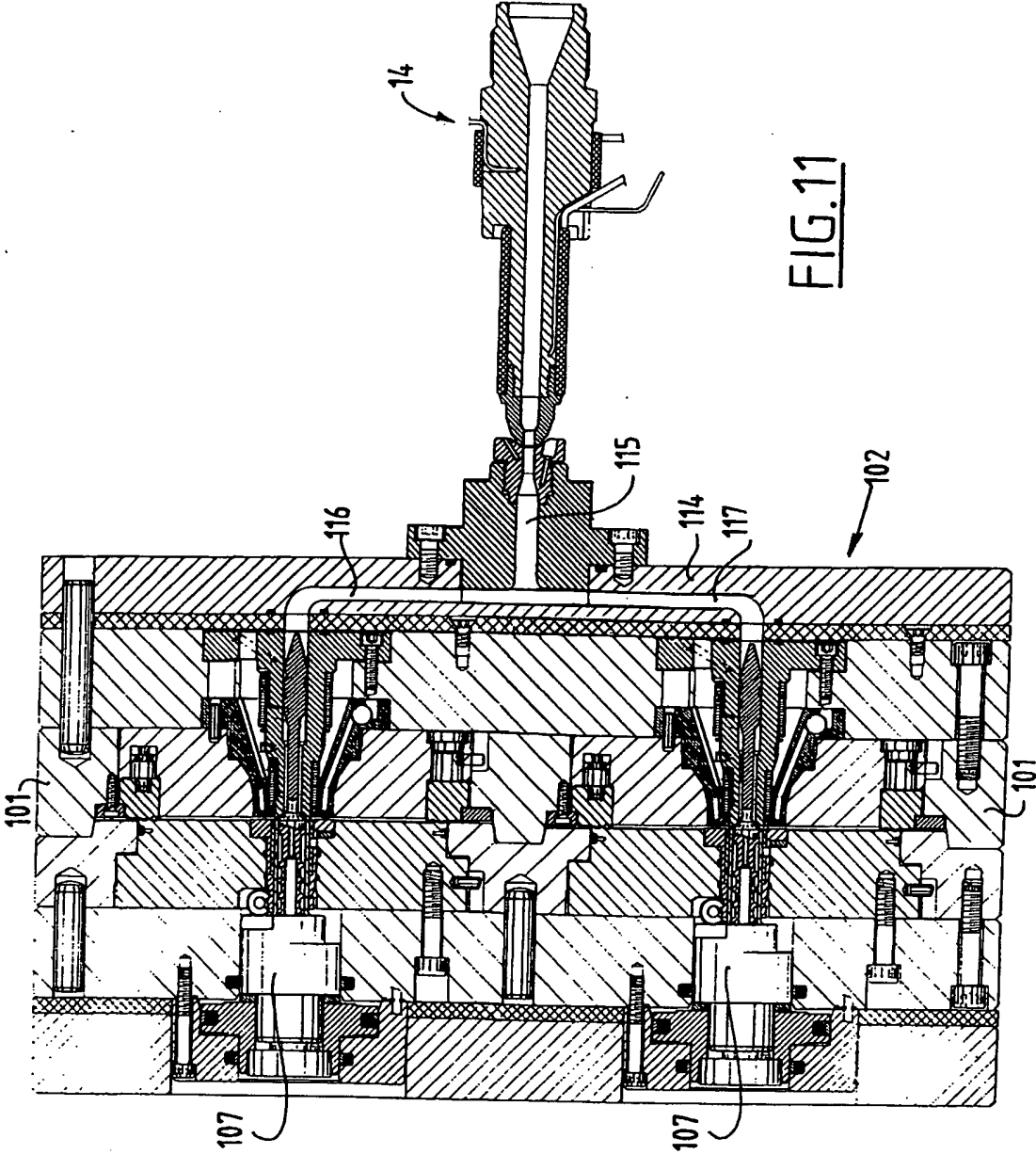


FIG. 10



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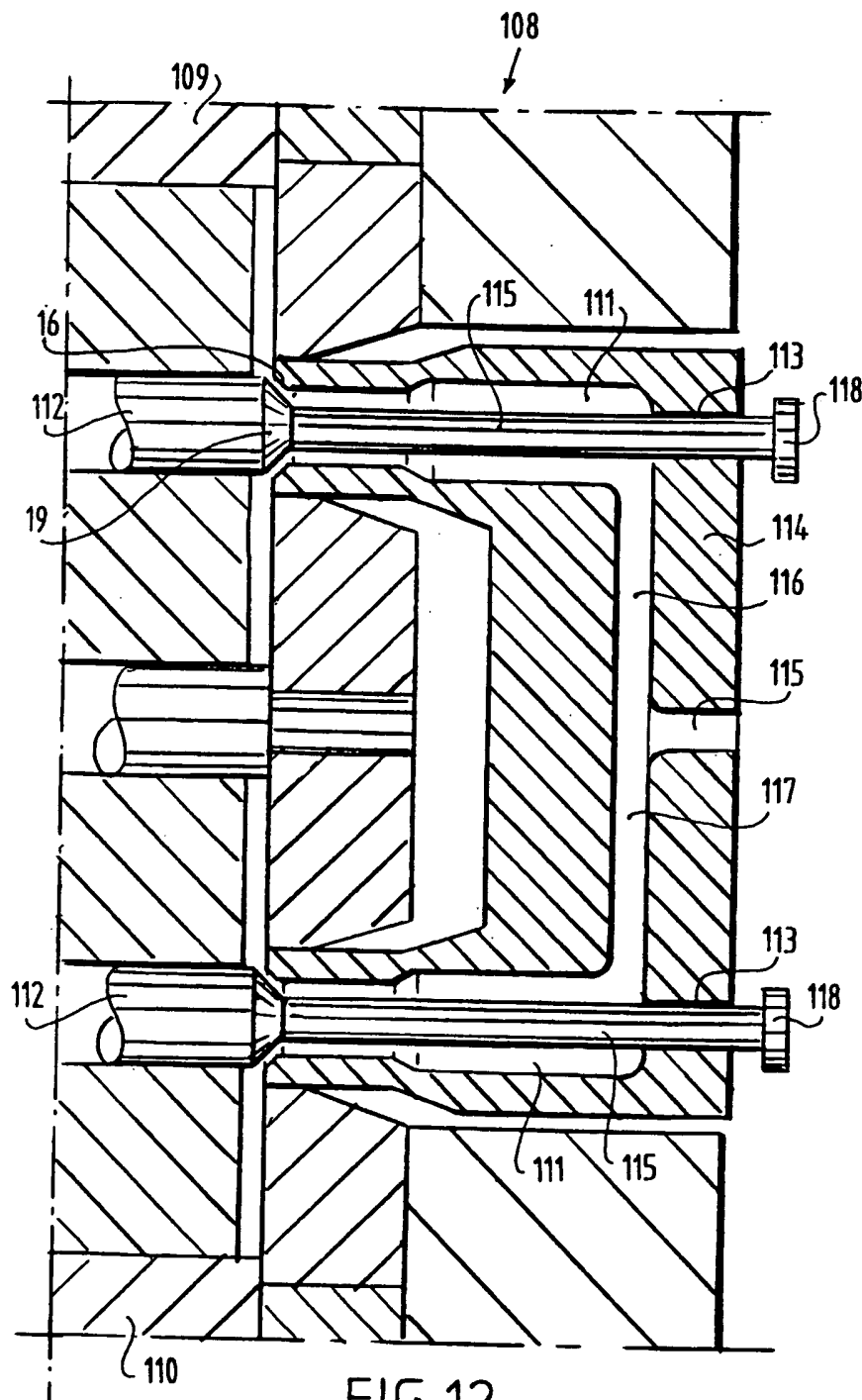


FIG.12

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/NL 99/00140

## A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 B29C45/28 B29C45/30 B29D17/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 B29C B29D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A Y	EP 0 051 252 A (DISCOVISION ASS) 12 May 1982 see page 13, line 22 - line 29	1-6, 8-10, 15 11 7, 17
Y	PATENT ABSTRACTS OF JAPAN vol. 011, no. 235 (M-612), 31 July 1987 & JP 62 048519 A (TOYODA GOSEI CO LTD), 3 March 1987 see abstract	7
Y	PATENT ABSTRACTS OF JAPAN vol. 011, no. 074 (M-568), 6 March 1987 & JP 61 229520 A (HITACHI LTD), 13 October 1986 see abstract	17
	-/-	

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

15 June 1999

Date of mailing of the international search report

22/06/1999

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2  
NL - 2280 HV Rijswijk  
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,  
Fax: (+31-70) 340-3016

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# INTERNATIONAL SEARCH REPORT

International Application No

PCT/NL 99/00140

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 92 08597 A (GPT AXXICON BV) 29 May 1992 cited in the application	1
A	US 4 077 756 A (MEADORS WILLIAM R) 7 March 1978	1
A	EP 0 066 649 A (DISCOVISION ASS) 15 December 1982	1,10
A	EP 0 117 510 A (GELLERT JOBST U) 5 September 1984 see figure 5	1,11
A	EP 0 825 008 A (HUSKY INJECTION MOLDING) 25 February 1998	1,11
A	US 4 808 106 A (VON HOLDT JOHN W) 28 February 1989	1,11
A	PATENT ABSTRACTS OF JAPAN vol. 011, no. 131 (M-584), 24 April 1987 & JP 61 272119 A (SHINAGAWA REFRACT CO LTD;OTHERS: 01), 2 December 1986 see abstract	4,5
A	EP 0 546 554 A (GELLERT JOBST U) 16 June 1993	7
A	US 3 642 418 A (HOLDT JOHN W VON) 15 February 1972	7
A	DE 32 01 710 A (GELLERT JOBST U) 26 August 1982	7
A	DE 43 00 336 A (MUELLER HANS) 15 July 1993	7
A	PATENT ABSTRACTS OF JAPAN vol. 007, no. 137 (M-222), 15 June 1983 & JP 58 051126 A (TOSHIBA KIKAI KK), 25 March 1983 see abstract	17



# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/NL 99/00140

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
EP 0051252	A	12-05-1982	US 4340353 A	20-07-1982
			AT 25612 T	15-03-1987
			AU 544950 B	27-06-1985
			AU 7428381 A	06-05-1982
			BR 8106960 A	13-07-1982
			CA 1158815 A	20-12-1983
			HK 15991 A	15-03-1991
			JP 1610797 C	15-07-1991
			JP 2034771 B	06-08-1990
			JP 61228924 A	13-10-1986
			JP 1345984 C	13-11-1986
			JP 57105329 A	30-06-1982
			JP 60023971 B	10-06-1985
			US 4405540 A	20-09-1983
WO 9208597	A	29-05-1992	JP 1988340 C	08-11-1995
			JP 4176619 A	24-06-1992
			JP 7010546 B	08-02-1995
			AT 126473 T	15-09-1995
			AU 655443 B	22-12-1994
			AU 8918391 A	11-06-1992
			CA 2095011 A	10-05-1992
			DE 69112221 D	21-09-1995
			DE 69112221 T	25-01-1996
			EP 0556266 A	25-08-1993
			ES 2075473 T	01-10-1995
			HK 198296 A	08-11-1996
			RU 2072918 C	10-02-1997
			US 5324190 A	28-06-1994
US 4077756	A	07-03-1978	NONE	
EP 0066649	A	15-12-1982	US 4394117 A	19-07-1983
			AT 19486 T	15-05-1986
			AU 546765 B	19-09-1985
			AU 7658881 A	16-12-1982
			BR 8106961 A	12-04-1983
			CA 1169611 A	26-06-1984
			HK 72589 A	14-09-1989
			JP 61228921 A	13-10-1986
			JP 1345985 C	13-11-1986
			JP 57203530 A	13-12-1982
			JP 60023972 B	10-06-1985
EP 0117510	A	05-09-1984	CA 1193817 A	24-09-1985
			AT 31893 T	15-01-1988
			DE 3468645 A	18-02-1988
			JP 1671474 C	12-06-1992
			JP 3038096 B	07-06-1991
			JP 59188417 A	25-10-1984
			US 4521179 A	04-06-1985
EP 0825008	A	25-02-1998	US 5783234 A	21-07-1998
			BR 9702661 A	27-10-1998
			CN 1172722 A	11-02-1998
			JP 10076551 A	24-03-1998
			US 5900200 A	04-05-1999

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/NL 99/00140

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4808106 A	28-02-1989	DE 3837375 A	01-06-1989
EP 0546554 A	16-06-1993	CA 2057438 A	12-06-1993
		AT 150359 T	15-04-1997
		CN 1073135 A,B	16-06-1993
		DE 69218355 D	24-04-1997
		DE 69218355 T	26-06-1997
		JP 5245884 A	24-09-1993
		US 5206040 A	27-04-1993
US 3642418 A	15-02-1972	NONE	
DE 3201710 A	26-08-1982	CA 1165525 A	17-04-1984
		JP 57152928 A	21-09-1982
DE 4300336 A	15-07-1993	SE 9200073 A	14-07-1993